

**ORTHOPAEDIC
— TRAUMA —
ASSOCIATION**

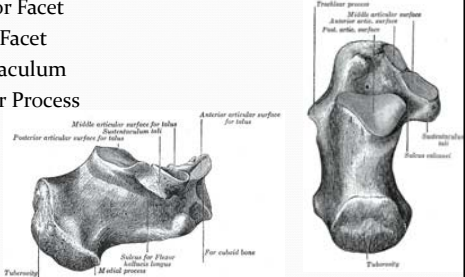
Calcaneus Fractures



Resident Comprehensive Fracture Course


Anatomy

- Posterior Facet
- Middle Facet
- Sustentaculum
- Anterior Process




Epidemiology

- 2% of all fractures
- Mechanism
 - Axial load
 - MVA
- 80-90% occur in men 20-40 years old
- 20% of individuals are incapacitated for 3-5 years



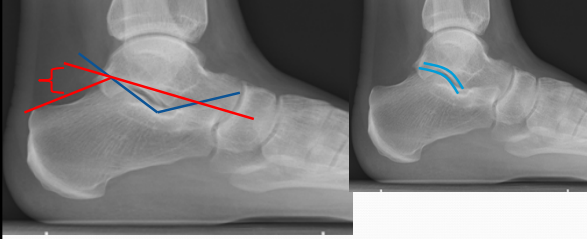
Epidemiology

- Rule of 10's
 - 10% with associated spine injuries
 - 10% Open injuries
 - 10% Bilateral
- 25% associated with other limb injuries
- Articular surface involved 75% of time



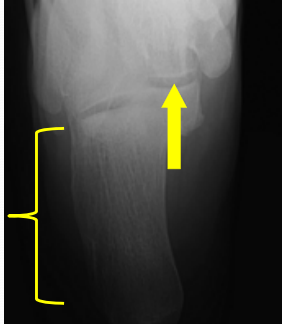
Radiographic evaluation

Bohler's angle (20-40 degrees)
Angle of Gissane (130-145 degrees)



Radiographs

- Radiographs
 - Harris view
 - Sustentaculum
 - Lateral wall
 - Hindfoot varus/valgus
 - 10 degrees of valgus



Radiographs

Broden View

- Provides visualization of the posterior facet articular surface

Computed Tomography

- Provides detailed imaging of the articular involvement

Classification

- Essex-Lopresti
 - Joint depression vs. tongue-type
 - Does not correlate with prognosis
 - Based upon plain radiographs
- Sanders
 - Evaluates posterior facet step-off
 - More prognostic/determine treatment
 - Based upon CT

Classification

Sanders

- CT scan semi-coronal image plane

Classification

Type IIB **Type IIIAC** **Type IV**

Classification



- Intra-articular tongue
- Fracture-dislocations

Fracture Patterns

- Extra-articular
 - 25-33% of calcaneus fractures
 - Twisting injury or direct impact (not compressive)
 - Involve anterior process, sustentaculum, body, or posterior tuberosity
- **Intra-articular (75%)**
 - **Involve Posterior Facet**
 - **Essex-Lopresti Classification**
 - **Sanders Classification**

Posterior Tuberosity Fracture

- Avulsion injury
 - Frequently occurs in osteoporotic bone due to a forceful contraction of the gastrosoleus complex
- More common in older and diabetic population
- Non-displaced = nonoperative
- Displaced = ORIF/percutaneous
- **Beware of soft tissues!**

Historical Relevance


- Have we come full circle?

“Ordinarily speaking, the man who breaks his heel bone is done, so far as his industrial future is concerned....”

Cotton FJ, et al. Results of fractures of the os calcis. Am J Orthop 1916;14: 290-8.

Historical Relevance

- 1950's
 - Introduction of operative treatment
- 1960's
 - Enthusiasm waned...
- 1980's
 - Limited exposure
- 1990's
 - CT re-defined fracture anatomy
 - Permitted more “refined” fracture care

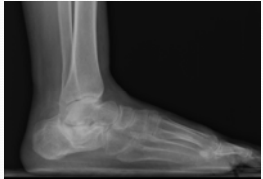

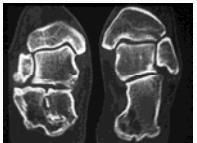


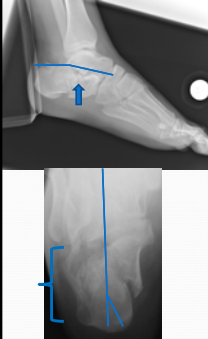
Operative Indications

- Why fix these?
 - >2mm displacement results in abnormal loading
 - Shortening impacts lateral column support
 - Hindfoot malalignment prevents unlocking of the subtalar complex
 - Height loss can result in anterior ankle impingement

Calcaneal Malunion

- Sub-fibular impingement
- Varus Alignment
- Horizontal talus/Anterior ankle impingement



- Deformities
 - Flattening of pitch/height
 - Loss of Böhlers angle
 - Articular incongruity
 - Horizontal talus
 - Hindfoot widening, varus positioning

Who do we fix?

- Nonoperative vs. Operative outcomes similar
- Work Comp worse
- ORIF > nonoperative outcomes
- ST arthrodesis more likely
 - Work Comp
 - Nonoperative
 - Böhler angle < 0 deg
 - Sanders Type IV
- Complications ORIF (25%) vs. Nonop (18%)

Buckley, R et al. Operative compared with nonoperative treatment of displaced intra-articular calcaneal fractures: a prospective, randomized, controlled multicenter trial. J Bone Joint Surg Am. 2002 Oct;84-(10):1733-44.

To Fix or Not to Fix?

- 108 fractures (93 patients)
- Follow-up minimum 10 yrs
 - Ave 15.22 yrs (10.5-21.2 yrs)
- 80 Joint depression/28 Tongue type
 - 70 Type II/38 Type III
- 103 Anatomic (95%)
- 3 Near-anatomic (1-3mm)
- 2 Approximate (3-5 mm)

Sanders R et al. Operative treatment of displaced intraarticular calcaneus fractures: long-term (10-20 years) results in 108 fractures using a prognostic CT classification. J Orthop Trauma. 2014 Oct;28(10):551-65.

To Fix or Not to Fix?

- 11% Local wound care
- One patient requiring ST arthrodesis for osteomyelitis
- 31 Fractures developed ST arthritis/requiring arthrodesis
 - Overall failure rate of 29%
 - Type III - 47% vs. Type II - 19%
- Type III 4x more likely to require arthrodesis

Sanders R et al. Operative treatment of displaced intraarticular calcaneus fractures: long-term (10-20 years) results in 108 fractures using a prognostic CT classification. J Orthop Trauma. 2014 Oct;28(10):551-65.

Operative vs. Nonoperative

- Six RCTs/Four CCTs
 - 891 patients
- ORIF favors
 - Recovery of Böhler angle
 - Stable calcaneal height/width
 - Improved shoe wear
 - More likely to resume pre-injury work
- Higher risk of complications

Jiang, N et al. Surgical versus nonsurgical treatment of displaced intra-articular calcaneal fracture: a meta-analysis of current evidence base. Int Orthop. 2012 Aug;36(8):1615-622

Operative vs. Nonoperative

- RCT
- 151 patients with acute displaced intraarticular calcaneus fractures
 - ORIF - 73
 - Nonop - 78
- 2 year F/U
- Complications more common with ORIF

Based on this study, calcaneus repair (ORIF or closed reduction and internal fixation) is not recommended for these fractures.

Griffin D, et al. Operative versus non-operative treatment for closed, displaced, intra-articular fractures of the calcaneus: randomised controlled trial. BMJ 2014.

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- 151 patients with acute displaced intraarticular calcaneus fractures
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“Based on these findings, operative treatment by open reduction and internal fixation is not recommended for these fractures”

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Decision Making

- Age < 50-55 years
- Health status
- Fracture pattern
- Timing

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Younger, healthier, active patients WITH fractures that can be fixed anatomically

Operative Goals



- Restore anatomy
- Restore function
- Avoid malunion
- Avoid complications

Operative Goals



- Restore posterior facet
- Restore height
- Reduction of heel width
- Decompression of subfibular space
- Realign tuberosity

Operative Treatment

- Percutaneous techniques
 - Open fractures (high grade)
 - < 4cm
 - Poor skin quality or comorbidities



Mehta S et al. A staged treatment plan for management of Type II and Type IIIA open calcaneus fractures. J Orthop Trauma. 2010 Mar;24(3):142-7.

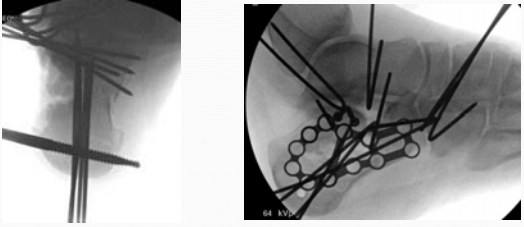
Operative Treatment

- External fixation
 - Minimally invasive
 - Restoration of morphology



Operative Treatment

- Extensile ORIF
 - Sander's Type II & III injuries



Operative Treatment

- ORIF with primary arthrodesis
 - Sander's Type IV (and select III) injuries
 - Poor soft tissues or non-reconstructable articular injury (Restore calcaneal pitch and height)



Operative Treatment

- Sinus Tarsi
 - Better alternative?




Sinus Tarsi

- 271 fractures (256 patients)
- Good to excellent outcome 75%
- Wound complications
 - Minor 4.1%
 - Major 0.7%
- Secondary subtalar arthrodesis 4.3%

Shepers T. The sinus tarsi approach in displaced intra-articular calcaneal fractures: a systematic review. Int Orthop. 2011 May;35(5):697-703.


Operative Treatment

- Lateral positioning
- Radiolucent table
- Fluoroscopy
 - Lateral
 - Broden
 - Harris view (Axial)
 - Contralateral



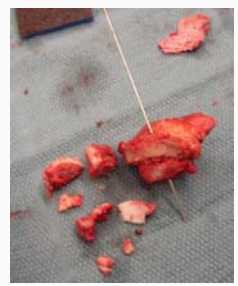
Extensile

- Incision
 - Full thickness soft tissue flap centrally
 - Beware of sural nerve proximally/distally
 - Protect peroneal tendons
 - LCA
- Exposure
 - Hands-free retraction
 - 5.0 mm Shanz pin in tuberosity



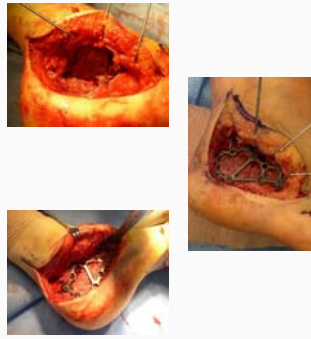
Extensile/Sinus Tarsi

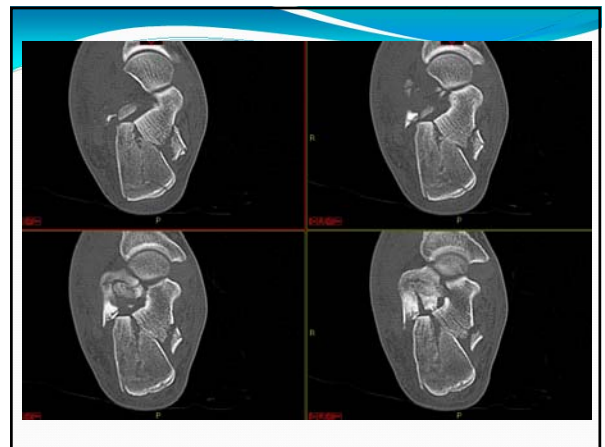
- Sequential reduction
 - (Front to back vs. Joint first")
- Anatomically fix the posterior facet
- Restore height (Bohler's) and angle of Gissane
- Restore normal valgus/neutral alignment



Extensile/Sinus Tarsi

- Temporarily fix everything with K-wires
- Stabilize posterior facet with lag screws
- Lag screws for anterior process if needed
- Plate application
- Void management
- Drain





Postoperative protocol

- Immobilize and elevate
- Wound Vac?
- Fracture brace
- Ankle/subtalar ROM
- Progressive weight-bearing at 8-12 weeks
- **Wound will dictate advance of motion**



Complications

- Subtalar arthrosis
 - Increased with nonoperative treatment
 - 6x more likely to undergo arthrodesis
- Subtalar stiffness
- Wound healing (2-10%)
 - Smokers
 - Diabetics
- Open fractures
 - 7-12% infection
 - 5% osteomyelitis
 - 5% amputation
- Delay in treatment



Outcomes

- Ideal treatment controversial
- Some subtalar stiffness can be expected
- Good results can be achieved after **selective operative fixation**
- Poorer results expected with, articular incongruity, flattened Bohler's angle, and Workman's Compensation related injuries
- **Avoidance of complications** is paramount for favorable outcomes

Thank You